

A Chronological Synopsis of the Dimensions of Expertise: Towards the Expert of the Future

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This paper concisely chronicles the evolution of the concept of expertise since the 1960s. After presenting the key themes of expertise throughout the years, we propose a breakdown of the evolution into three waves: information-processing wave, speed / problem solving wave, and emotional intelligence / ways of expertise wave. We then show the mimicking of this progression with other fields such as business and psychology while highlighting the probable characteristics of the 'future' expert.

Keywords: Measure, Research Methods, Expertise

Since its humble beginnings in the late 1950s, expertise has slowly filtered through the human resource development literature as it has been seen as one of the most powerful tools for improving performance (Swanson & Holton, 2001). The question of whether experts are made through deliberate practice and years of experience (Rossano, 2003) or born emerged as early as in the 1980's (Staszewski, 1988; Ericsson & Charness, 1994).

Because of its potential relationship with increased performance in organization, the past 15 years have seen a crescendo in the pace of expertise research, as indicated in the growing number of peer-reviewed publications in the area (Swanson & Holton, 2001). This increased interest has led to the creation of many views of what the concept of expertise actually is and in fact, there are as many definitions of "experts" as there are researchers who study them (Shanteau, 1992). These conceptual research studies have identified various common themes or dimensions associated with the concept. The following section presents an embryonic version of the findings.

Methodology

Table 1 allows for an overall view of how the concept has grown, and what it has grown into. This synopsis is based on a fairly thorough review of the literature on expertise in the fields of HRD, management, and education. Definitions of the concept were sought throughout the literature, which essentially consisted of refereed journals and books on the topic published mainly in the United States.

Table 1. *Chronological Development of the Themes of Expertise*

Authors	Themes
Galton, 1869	Outstanding performance is due to inherited special abilities. Attempts to account for the accomplishments of eminent individuals by studying their familial and genetic origins
de Groot, 1946 (1978)	Knowledge about aspects of a task domain. Master chess players faster in reaching decisions
Miller, 1956	Short-term memory is limited to 7 chunks of information (5 to 9). Planning is a fundamental cognitive process
French & Raven, 1959	Expert power: based on the perception that other has some knowledge or expertise
de Groot, 1966	Master chess players remember board positions and associate good moves. More accurate
Collins & Raven, 1969	Expert power: stems from person's attribution of superior knowledge or ability to other

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Newell & Simon, 1972	Problem-space theory: we search for a solution among a set of possible solutions. Perceptual ability
Chase and Simon, 1973 Johnson et al., 1981	The 10-year rule across areas for expert performance (length of experience). Chunking Theory (CT): recognition of important features and patterns. Experts are better able to identify patterns
Webster's Dictionary, 1976	Expert: having, involving, or displaying special skill or knowledge of a particular subject through training or experience
Charness, 1981	Chess experts use similar hierarchically organized structures as they assess move sequences while evaluating chess positions and planning moves
Chi, Glaser, & Rees, 1982	Difference between experts and novices reflects qualitative differences in the organization of knowledge and its representation. Automation speeds up process without loss of quality of performance and thus frees up resources that can be used to learn new information
Chase & Ericsson, 1982	Skilled Memory Theory: people can learn to hold virtually unlimited amounts of information in working memory with sufficient practice. Expert-level performance depends upon experts' efficient use of a vast, domain-specific knowledge base. Through practice in a domain, experts acquire knowledge structures and procedures for efficiently encoding and retrieving task-relevant information in long-term memory (LTM)
Greeno & Simon, 1984	Superior pattern recognition results in the ability to do forward reasoning
Harmon & King, 1985	Skill and knowledge possessed by some people that result in performance far above the norm
Anderson, 1985; Dreyfus & Dreyfus, 1986	Distinguish high performers from others by the way they think and solve problems rather than simply by their knowledge
Doll & Mayr, 1987	IQ does not distinguish experts (expertise is not related to IQ)
Johnson, 1987	Experts excel mainly in their own domains; they perceive large, meaningful patterns in their domain; They are faster at performing the skills of their domain, and they quickly solve problems with little error; They have superior short-term and long-term memory; They have better recall; They see and represent a problem in their domain at a deeper (more principled) level; novices tend to represent a problem at a superficial level; experts analyze problems qualitatively; they have strong self-monitoring skills.
Gentner, D. R., 1988	One major characteristic of expert performance: individual differences (in error, patterns of error). There are many ways to be an expert
Staszewski, 1988	Experts are made, not born. Knowledge acquired through long and steady practice is the essential ingredient of expertise. Problem solving is critical. Not connected to general aptitude. Motivation is essential. Skilled memory is a general component of expert knowledge

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Gibbins, 1988	Expert as to the task: because of what he or she does, the individual is recognized by others as being expert
Bédard, 1989	Expertise: possession of large body of knowledge and procedural skill
Charness, 1989	Efficient and reliable storage of information in memory is important
Davis & Salomon, 1989	Expertise is a performance-based notion
Hinkin & Schriesheim, 1989	Expert power: the ability to administer to another information, knowledge, or expertise
Frensch & Sternberg, 1989	Expert: an ability acquired by practice to perform qualitatively well in a particular task domain
Bonner & Lewis, 1990	Expertise is task-specific superior performance
Patel & Groen, 1991	Expert: An individual with specialized knowledge of a domain. She sees patterns based on automatic retrieval from complex networks of stored knowledge. Ordinal scale with 6 categories: lay person, beginner, novice, intermediate, subexpert, and expert
Salthouse, 1991	Degree of expertise can be displayed on a continuum from novice behaviors to expert behaviors. A possible distribution could look like a normal curve
Bédard & Chi, 1992	Experts know more about their domain, their knowledge is better organized, they perform better than novices; their skill is domain specific; there are many situations in which they don't excel
Shanteau, 1992	Expert advantage depends on the task at hand. Experts need to engage in expert-like behaviors in order to maintain their self-image. Expertise is acquired through stages of development (akin to the mental development of children)
Rozycki, 1992	Expert teachers are ethical
Spencer & Spencer, 1993	Depth of knowledge, breadth, acquisition of expertise, and distribution of expertise
Bédard, Chi, Graham, & Shanteau, 1993	5 conditions for expertise: domain knowledge, psychological traits, cognitive skills, use of various decision strategies, and task characteristics
Bereiter & Scardamalia, 1993	Not all experience leads to expertise; experience may also lead to a deepening rut. Expertise is acquired by reinvesting time and energy and continually learning to meet new challenges (progressive problem-solving). Approach to new problems is what differentiates experts from non-experts
Kochevar, 1994	Power of expert performance is rooted in the superiority of his/her operative knowledge or expertise
Ericsson & Charness, 1994	Expertise is not a function of high IQ. Expert performance is not innate but may be function of personality. Skills associated with high performance are domain specific

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Proctor & Dutta, 1995	Expert performance is an extreme case of skill acquisition. Features common to all expert performers, which suggests that they have similar cognitive, perceptual, and motor processes. Perceive complex patterns in a domain. Have short-term and long-term memory
Ericsson & Kintsch, 1995	Long-term working memory theory (LTWMT). Construction of hierarchical retrieval structure
Ericsson & Lehman, 1996	Experts select relevant information and encode it in special representations in working memory that allow planning, evaluation, and reasoning about alternative courses of action
Charness, Krampe, & Mayr, 1996; Rossano, 2003	To acquire expertise one must be able to engage in deliberate practice; Expert has retrieval structure
Regehr & Norman, 1996	Categories, ideas, and case examples are conceptually related in complex and meaningful ways
Martin, 1996	Can use his or her high level of knowledge and skills in practical ways
Darling-Hammond & Ball, 1997	Teacher expertise involves having a deep understanding of both content and students
Kuchinke, 1997	Expertise functions as a value judgment. Seen as highly skilled and knowledgeable in specific area. Up-to-date through practice and continued learning and committed to the area of expertise. Keywords: mastery, skill, competence, specialization, knowledge, savvy, and authority. Errors should be allowed to build expertise. Behaviors must be distinguished from their effects or results
Tiberius, Smith, & Waisman, 1998	Expertise is based on special knowledge, skills, or talent
Bond, Jaeger, Smith, & Hattie, 2000	Thirteen dimensions of teacher expertise: use of knowledge, deep representation, problem solving, improvisation, classroom climate, multidimensional perception, sensitivity to context, monitoring learning and providing feedback, test hypotheses, passion for teaching and learning, respect for students, challenge, and deep understanding
Jeffers & Fong, 2000	Teacher's knowledge of a subject matter, child development, curriculum, and teaching experience
Swanson & Holton, 2001	Expertise: "displayed behavior within a specialized domain and / or related domain in the form of consistently demonstrated actions of an individual that are both optimally efficient in their execution and effective in their results." (p. 241). Dimensions of expertise: Problem-solving skills, Experience, Knowledge. It is dynamic and domain-specific. Human expertise is the ability to do consistently the right thing in the right way
Ericsson, 2002	The level of skill one attains in a domain has been shown to be directly related to the amount of deliberate practice one engages in
Weiss & Shanteau, 2002	It is the behavior of a person that is or is not expert

Table 1. *Chronological Development of the Themes of Expertise (Con't)*

Weiss & Shanteau, 2003	Categories of expertise: Evaluation + qualitative or quantitative expression= expert judgment; Evaluation + projection= expert prediction; Evaluation + communication= expert instruction; Evaluation + execution= expert performance
Rossano, 2003	Expertise can be used as a basis for cross-species comparisons of consciousness; The evolution of human consciousness can be assessed using fossil evidence of skilled behavior as a measure of consciousness
Smith & Strahan, 2004	Six central tendencies across teachers: a sense of confidence in themselves and in their profession; talk about their classrooms as communities of learners; maximize the importance of developing relationships with students; demonstrate a student-centered approach to instruction; make contributions to the teaching profession through leadership and service; show evidence that they are masters of their content areas
Germain, 2005; Subramini et al., 2004	Managerial expertise: education, experience, performance, recommendations, written evidence, social skills
Germain, 2006	College instructor expertise: knowledge, social skills, knowledge transfer, experience, classroom climate, education, respect for students, personality

At first sight, expertise seems to have been influenced by the evolution in other fields. The breakdown is presented below as three progressive eras have been identified by Kuchinke (1997) and Holyoak (1991) as generations or schools of thought. We will name them 'waves' (Figure 1).

The first wave (Information-Processing / Artificial Intelligence) started in the 1950s with the increase interest in computer science and artificial intelligence in general. Researchers were primarily concentrating on the functioning of memory (de Groot, 1966), on how information was processed and on how decisions were made. At the late stage of this wave the concept of memory (the system by which we retain information and bring it to mind) was further investigated and broken down into three stages: sensory memory, short-term memory (STM), and long-term memory (LMT) (Atkinson & Shiffrin, 1971). Such findings influenced the work of researchers in expertise (cf. Chase & Simon, 1973; Chase & Ericsson, 1982). Research on memory was further investigated by Chase and Ericsson (1982) who spoke of Skilled-Memory Theory (SMT). This first wave of expertise theories described heuristic processes that were thought to be generally applicable to almost all domains. However, they did not prove attainable for more complex, knowledge-rich tasks and such general heuristic search methods are weak and characteristic of novices rather than experts (Kuchinke, 1997).

This led to the second wave from which most of the well-known characteristics of expertise originate: The problem-solving and speed wave. This wave, which started in the late 1980s, shows a change in gear: speed and problem-solving were in the agenda. Also, interest in human intelligence increased and the Stanford-Binet Intelligence Scale and the Wechsler scales of intelligence started to be commonly used. This influenced the research of Doll & Mayr (1987) who examined whether IQ was correlated with expertise. There is however a growing number of research findings that form exception to the rules of second-generation theories. For instance, experts do not always reach superior results despite their superior mental powers. Also, some knowledge can be transferred across domains. Finally, teaching novices expert rules (when identified) does not lead to better performance.

With its beginning in the mid-nineties, the third wave (emotional intelligence / ways of expertise) in addition to being influenced by Holyoak's (1991) work on connectionism (the ability to create instantaneous cognitive networks and connect many small bits of information in a meaningful way) seems to have been greatly inspired by the business issues of the time: talent (war for talent), ethics and emotional intelligence (EI or EQ) (Goleman, 1995). Talent, as defined by Michaels, Handfield-Jones, & Axelrod (2001), is shorthand for key employees who possess a strategic mind, leadership ability, communications skills, the ability to attract and inspire people, entrepreneurial instincts, functional skills, and the ability to deliver results. Interestingly, many of these qualities are found in the latest research of Smith & Strahan (2004) and Subramini et al. (2005), among others.

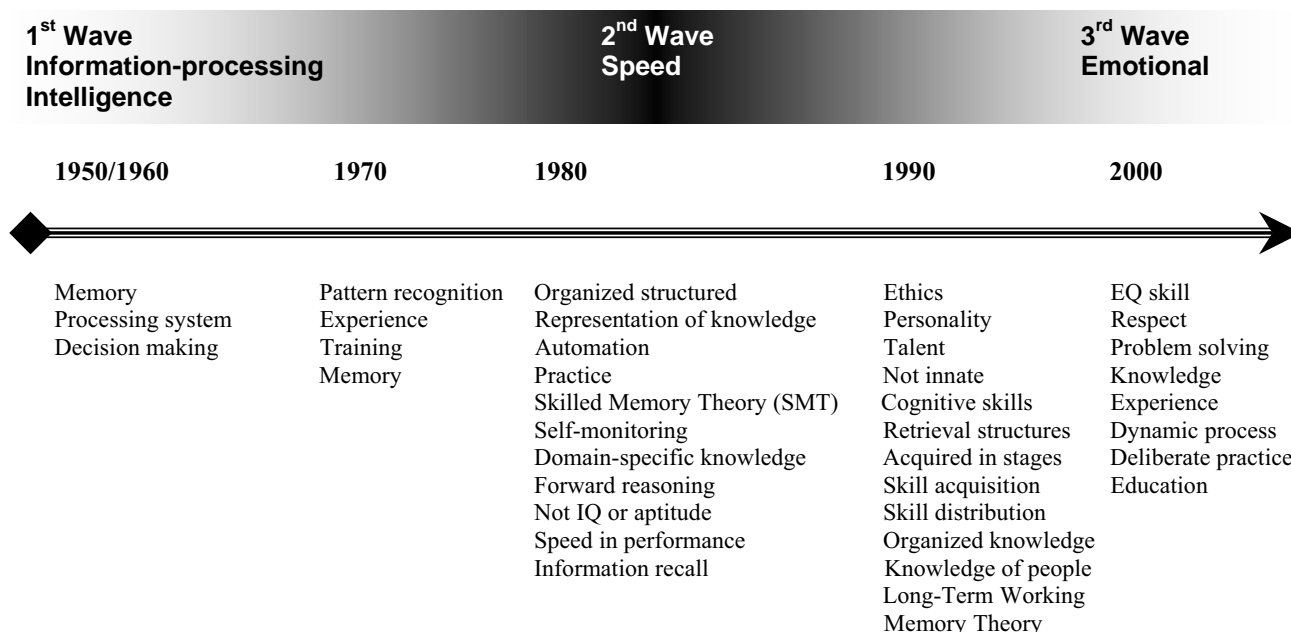


Figure 1. *Waves and Keywords of Theories of Expertise*

Impact on the Field of Human Resource Development and Contribution to Practice

The importance of expertise has been increasing in the field of Human Resource Development and has been reflected in HR practices throughout the globe. Indeed, since the concept has been linked to performance (Swanson & Holton, 2001) many HR directors have considered how to increase expertise of employees and how expertise could be transferred to workers. This synopsis allows practitioners to see how the concept has evolved and may provide them with objective concepts they now need and will need to focus on when trying to increase performance, such as emotional intelligence or problem solving training, as shown in Figure 1.

Conclusion

From this succinct overview of the evolution of the concept of expertise over the past half-century, it seems clear that the progression mirrors the one found in other fields, primarily psychology and business from hereditary characteristics (which echoes the trait theory of leadership) to behavioral theories, to emotional intelligence. It is evident that this incessant, dynamic change is leading us to new conclusions on what 'expertise' is and on what it will become in the twenty-first century. New findings show that an expert is now 'supposed to' have respect for others and should be able to transfer her or his knowledge (Germain, 2006). We can hypothesize that the next generation (or 4th wave) of experts may be a more 'complete' human being, one that encompasses numerous individual characteristics while being unique; So may be the *Expert of the Future*.

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